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EXAMINER	
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ART UNIT	**PAPER NUMBER**
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Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	09/896,798	LUO ET AL.	
	Examiner	Art Unit	
	James A. Thompson	2625	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *10 May 2006*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-26* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-26* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *29 June 2001* is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☐ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO/SB/08)
Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413)
Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____.

DETAILED ACTION

Response to Arguments

1. Applicant's arguments filed 10 May 2006 have been fully considered but they are not persuasive.

Regarding page 7, line 2 to page 12, line 9: The combination of Murayama (US Patent 5,936,684) and Revankar (US Patent 5,649,025) would not be recursive. As clearly set forth on pages 3-4 of the previous office action, dated 01 February 2006 and mailed 08 February 2006, Murayama is relied upon to specifically teach the steps of calculating and assigning, which are recited in claim 1. Revankar is merely relied upon to teach that the steps of calculating and assigning, which are taught by *Murayama*, are performed in a specific order. While Revankar may also perform the steps of calculating and assigning in a recursive manner, Revankar has not been relied upon for any of its teachings with respect to any of the types of iterative thresholding described therein. Thus, the combination of Murayama and Revankar would not require any kind of iterative processing.

While one of ordinary skill in the art at the time of the invention may have been able to apply the teachings of Revankar to the teachings of Murayama in a different way than that which is set forth by Examiner, this in no way invalidates the combination specifically set forth by Examiner in said previous office action. Also, in the prior art rejections set forth in said previous office action, Murayama is the primary reference, not Revankar. Hence, it is the system of Murayama that is modified in an obvious manner according to the teachings of Revankar, not the other way around, as Applicant seems to be requiring by only considering aspects of Revankar.

Additionally, Applicant is focusing on many detailed aspects of the teachings of Revankar (the secondary reference), which have not at all been relied upon by Examiner, instead of considering the combination as expressly set forth in said previous office action. Thus, Applicant is essentially attempting a piecemeal analysis by only considering what Revankar teaches with respect to the steps of calculating and assigning. Applicant is respectfully reminded that one cannot show nonobviousness by attacking references individually where the rejections are based on combinations of references. See *In re Keller*, 642 F.2d 413, 208 USPQ 871 (CCPA 1981); *In re Merck & Co.*, 800 F.2d 1091, 231 USPQ 375 (Fed. Cir. 1986).

Finally, the newly added limitations which recite that the values of M and N are unchanging are also present in the teachings of Murayama, the primary reference, as set forth in detail below. Revankar has not been relied upon in any way to teach anything with respect to the values of M and N. Applicant would appear to be attempting to force a completely different combination for Murayama in view of Revankar than the combination clearly set forth by Examiner in said previous office action.

Regarding page 18, line 3 to page 22, line 8: Again, as argued above, the combination of Murayama in view of Revankar is not recursive. Applicant is applying portions of Revankar which where not relied upon by Examiner in an attempt to force a different combination of references than that which is clearly set forth in said previous office action. In said previous office action, Revankar is relied upon to teach what Murayama expressly lacks, which is "setting initial values of M cluster centers; and repeating said assigning and said calculating until a predetermined stopping condition is reached and, thereby,

final values of said cluster centers are defined." Revankar sets initial values of M cluster centers (column 5, lines 6-9 of Revankar); and repeats the overall *threshold operations* [not the entire process] (figure 6(304,306) and column 6, lines 56-65 of Revankar) until a predetermined stopping condition is reached (column 7, lines 1-5 of Revankar) and, thereby, final values of said cluster centers are defined (column 7, lines 1-5 of Revankar). Thus Revankar teaches that a particular step is repeated, which is also recited in claim 21. Revankar is *not* relied upon for any kind of teaching stating that the entire method is recursive. Again, Applicant is trying to force a different kind of combination than that which is expressly set forth by Examiner, and thus does not properly address the actual combination set forth in said previous office action.

Furthermore, the portions cited by Applicant [column 1, lines 14-27 and lines 37-51; column 2, lines 16-23; and column 15, lines 1-6 of Murayama] in this and other sections of Applicant's present arguments refers to difficulties encountered in a different method, namely the "Ohtsu method". Murayama is simply explaining why his method is being developed by comparing it with the prior art. The method of Murayama is a method that is distinct from the Ohtsu method and far simpler than the Ohtsu method. When Murayama states that a simple process for setting multiple thresholds is desired (column 2, lines 16-24 of Murayama), this statement is meant to show the contrast between the method of Murayama and the Ohtsu method. It is not a contradiction to make a method simpler than another method, and then add to the simpler method or make some steps recursive with a stopping point. For example, the Ohtsu method is only suitable for binary processing since the amount of computations increases

rapidly with an increasing number of threshold values, such as the number of threshold values applied in Murayama. The Murayama method is much simpler, allowing for a much faster calculation of multiple thresholds. Improving the results by making the steps of assigning and calculating recursive and/or by specifically using K-means clustering (as recited in claim 2) still provides a method that is simpler and improved over the Ohtsu method since the Ohtsu method would take much longer to achieve the same improved results as the method taught by the combination of Murayama and Revankar. In other words, the Ohtsu method is already burdensome to use for even simple results, and if the Ohtsu method were altered to obtain the improved results - obtainable from the combination of Murayama and Revankar - an enormously greater amount of processing would be required. The method of Murayama is a simple method, and can thus have the steps of calculating and assigning performed iteratively without vastly degrading performance. The same cannot be said of the Ohtsu method.

Additionally, Revankar does teach "setting initial values of M cluster centers" since column 5, lines 6-9 of Revankar (as cited in said previous office action) states "Step 2: Use a discriminant analysis-based method to find a threshold T_I for the histogram H...". The thresholds are initially found based on the histogram, which is similar to the threshold setting based on histograms taught by Murayama (column 8, lines 44-49 of Murayama), and thus the M cluster centers are initially set since the cluster centers are based upon the distribution of the histogram itself.

Also, Revankar does teach "repeating the overall threshold operations (figure 6(304,306) and column 6, lines 56-65 of

Revankar) until a predetermined stopping condition is reached (column 7, lines 1-5 of Revankar) and, thereby, final values of said cluster centers are defined (column 7, lines 1-5 of Revankar)" [page 6, lines 19-24 of said previous office action]. Examiner has cited more than just column 7, lines 1-5 of Revankar, as a simple reading of the rejection clearly shows. Figure 6 of Revankar shows the recursive threshold processor (304) and column 6, lines 56-65 of Revankar describes recursive thresholding of the histogram, resulting in outputs of the threshold values and the goodness function. Thus, there is a stopping condition since, without a stopping condition, a recursive procedure will continue without ceasing.

Finally, the motivation to combine the references set forth in said previous office action is valid. Examiner has not stated that the motivation to combine was for the purpose of applying multiple thresholds. The motivation to combine is so that multiple thresholds can be applied to each of a plurality of separate segments of an image, rather than performing a thresholding for the entire image. In Murayama, multiple thresholds are applied to the entire image as a single entity. In Revankar, multiple thresholds are applied to different sections, each section as a separate entity. Thus, applying the teachings of Revankar provide for a better halftoning process. Applying these multiple regions would not degrade the result of Murayama, but would enhance the overall result. While more calculations may be required to generate the resultant image, this in no way renders Murayama non-functional. Murayama in view of Revankar may take longer to process an image, but this is a trade-off often made in the image processing arts when higher quality is desired, rather than quick but shoddy results.

Regarding page 22, line 9 to page 23, line 16: The rejection of claim 22 is not self-contradictory since Applicant is taking a sentence from the rejection of claim 21 out of context. The quoted portion of the office action clearly conveys that the threshold determination is performed *iteratively*, *as per* the teachings of Revankar, rather than once. Applicant is again attempting to read in every last bit of the teachings of Revankar, while ignoring the clear teachings from the primary reference of Murayama. The teachings from Murayama relied upon to reject claims 22 and 23 teach the limitations specifically recited in claims 22 and 23. Examiner has clearly not completely replaced the teachings of Murayama with the teachings of Revankar by the sentence quoted out of context by Applicant, but has simply combined the references so that a particular step is performed iteratively rather than once. There is no technical reason why the steps of assigning and calculating, taught by Murayama, cannot be iteratively performed *via* that obvious combination of the teachings of Murayama and Revankar.

Regarding page 23, line 17 to page 27, line 19: Applying K-means clustering in no way renders Murayama unsatisfactory for its intended purpose. While additional computations may be required in order to implement a K-means clustering operation, this does not destroy the functionality of Murayama, it simply requires a longer time to perform the overall computations. The determination of thresholds such as to generate a good quality halftone image, which is the purpose of Murayama, is still served by the inclusion of a K-means clustering operation. A K-means clustering operation simply changes the exact nature of how the individual threshold levels are determined. Murayama teaches a particular type of clustering based on a histogram

distribution. K-means clustering is simply another type of clustering algorithm that can readily be applied to the system of Murayama.

Applying a K-means clustering would optimize the cluster assignments for pixels, as relied upon for the motivation to combine. Even though there are two stopping criteria (one-percent change in a single iteration or the maximum number of iterations), the first criterion clearly provides good results, and the second criterion can be set to any arbitrary number. In iterative processing such as the K-means clustering, this is done since it is sometimes the case that the iterative processing will either never quite reach the criterion set for iterative convergence, or will not reach said criterion until a number of iterations has been performed which would make the processing highly inefficient. However, this does not mean that the results are bad results. It simply means that the results did not fully converge such that the first criterion was met, and additional iterations will not significantly help or improve the overall results. This is a common computational tactic in recursive algorithms that, in certain circumstances, do not have good convergence characteristics.

Finally, it would necessarily be the case that the "K" taught by Merickel equals the "M" taught by Murayama since both are the number of clusters that are set for the image thresholding.

Regarding page 27, line 20 to page 29, line 21: The portion of Ishiguro (US Patent 6,501,566 B1) clearly sets forth the fact that the quality of the image data produced by conventional multi-value error diffusion process circuits is degraded since the entire original document is subjected to the error diffusion

process with a predetermined value. Thus, it is clear that image degradation under the conditions of applying an error diffusion process with a predetermined value to an entire document is a common result, as stated by Examiner. The cited portion of Ishigura itself is the demanded documentary support since the degradation of image quality is shown to occur in "conventional" (i.e., "common", "typical", "ordinary") multi-value error diffusion process circuits. The "common result" (or, in other words, a "typical result") is not some subjective statement, as Applicant alleges, but is simply a result that generally occurs under the conditions of applying an error diffusion process with a predetermined value to an entire document. The system of Murayama also applies conventional multi-value error diffusion, and is thus aided by the application of the teachings of Ishiguro to the system of Murayama.

Regarding page 29, line 22 to page 31, line 2: Applicant's repeated arguments with respect to cumulative and non-cumulative histograms have already been exhaustively addressed in previous office actions. In brief, cumulative histograms and non-cumulative histogram are simply different mathematical *representations* of data. There is nothing of substance altered by using a different mathematical representation.

In Murayama, a rapid change in the cumulative frequency can determine the placement of threshold values (see figure 2b(e.g., "th[1]") of Murayama). In Ishiguro, it is the highest peaks in the non-cumulative histogram that determine where a threshold is to be set (see figure 7 and column 7, lines 23-26 and lines 60-65 of Ishiguro). For a particular data set, a high peak at one point in a corresponding *non-cumulative* histogram results in a rapid rise in the value of a *cumulative* histogram at the same

point. Thus, the difference between the histogram-based threshold setting taught by Murayama and the histogram-based threshold setting taught by Ishiguro is merely the manner in which the data is *represented*. The pixel data itself is the same and the setting of the thresholds based on said pixel data operates in the same fashion. It is merely the manner in which Murayama and Ishiguro choose to *depict* the pixel data that is different. In both Murayama and Ishiguro, when the number of pixels of a certain pixel value is large, a threshold is set either at that point or near that point.

Regarding page 31, line 3 to page 32, line 16: Applicant's arguments in this section amount to a mere allegation of patentability. Examiner has already demonstrated adequate reasons for the rejections of the disputed claims, and Applicant has provided no additional reasons beyond those discussed above for considering the claims patentable over the applied prior art.

2. Applicant's arguments, see **page 12, line 10 to page 18, line 2**, filed 10 May 2006, with respect to the rejections of claims 16-20 under 35 USC §103(a) have been fully considered and are persuasive. Therefore, the rejection has been withdrawn. However, upon further consideration, new grounds of rejection are made in view of a reconsideration of the previously cited prior art references.

Claim Rejections - 35 USC § 101

3. 35 U.S.C. 101 reads as follows:

> Whoever invents or discovers any new and useful process, machine, manufacture, or composition of matter, or any new and useful improvement thereof, may obtain a patent therefor, subject to the conditions and requirements of this title.

4. **Claims 1-11 and 13-26 are rejected under 35 U.S.C. 101 because the claimed invention is directed to non-statutory subject matter.**

Claims 1-11 and 13-26 recite methods for multitone processing an N level digital image. All of the steps of each method simply operate upon internal digital data, namely pixel values, reconstruction levels, thresholds, and histograms, among other data. Thus, claims 1-11 and 13-26 are simply algorithms which manipulate non-functional descriptive data. Furthermore, claims 1-11 and 13-26 have no substantial practical application since claims 1-11 and 13-26 do not produce a concrete, tangible and useful result. Claims 1-11 and 13-26 merely manipulate data internally, and do not produce any form of output or provide any other type of concrete, tangible and useful result. Thus, claims 1-11 and 13-26 are non-statutory.

Claim Rejections - 35 USC § 102

5. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless -
>
> (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

6. Claims 1 and 12 are rejected under 35 U.S.C. 102(b) as being anticipated by Murayama (US Patent 5,936,684).

Regarding claims 1 and 12: Murayama discloses a method for multitone processing an N level digital image to produce an M level digital image (figure 4 and column 9, lines 34-39 of Murayama) wherein M and N have unchanging values and M<N (e.g., M=4, N=256), comprising the steps of:

- determining M reconstruction levels (M<N) based on the gray level distribution of the N level image (figure 4 and column 9, lines 34-39 of Murayama); and
- applying multilevel error diffusion (column 14, lines 56-62 of Murayama) to the N level digital image using the M reconstruction levels to produce the M level digital image (figures 8-9 and column 12, lines 58-62 of Murayama),
- wherein said determining further comprises:
    - assigning all of the pixels of said N level image into M groups corresponding to said M reconstruction levels (figure 4 and column 9, lines 7-18 of Murayama), and
    - following said assigning, calculating each of said M reconstruction levels using the pixels of the respective said groups (figure 4 and column 9, lines 34-39 of Murayama). Since the calculating of each of said M reconstruction levels requires the use of the pixels of the respective said groups, then it is inherent that said calculating follows said assigning.

Claim Rejections - 35 USC § 103

7. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

8. Claims 4-6 are rejected under 35 U.S.C. 103(a) as being unpatentable over Murayama (US Patent 5,936,684) in view of Ishiguro (US Patent 6,501,566 B1).

Regarding claims 4-6: Murayama does not disclose expressly that the first and last levels of the M levels are predetermined, wherein the first level is zero and the last level is the maximum possible level.

Ishiguro discloses that the first and last levels of the M levels are predetermined, wherein the first level (S0) is zero and the last level (S3) is the maximum possible level (figure 7; column 7, lines 24-26 and column 8, lines 31-34 of Ishiguro). Murayama and Ishiguro are combinable because they are from the same field of endeavor, namely digital image binarization. At the time of the invention, it would have been obvious to a person of ordinary skill in the art to preset the first level to zero and the last level to the maximum possible level, as taught by Ishiguro. The suggestion for doing so would have been that halftone text data, which has lot of dark pixel surrounded by light pixels, is a typical feature in images (column 2, lines 61-63 of Ishiguro). This produces the peaks at the low density end and high density end of the histogram, such as shown in

figure 7 of Ishiguro. Thus, the first and last levels should be set to zero and the maximum possible level, respectively. Therefore, it would have been obvious to combine Ishiguro with Murayama to obtain the invention as specified in claims 4-6.

9. Claim 7 is rejected under 35 U.S.C. 103(a) as being unpatentable over Murayama (US Patent 5,936,684) in view of Merickel (US Patent 4,945,478) and Eschbach (US Patent 5,565,994).

Regarding claim 7: Murayama does not disclose expressly that the N level digital image has multiple channels and K-means clustering and multi-level error diffusion are performed on each of the multiple channels independently.

Merickel discloses performing K-means clustering on a N level digital image (column 11, lines 26-31 and column 15, lines 9-16 of Merickel).

Murayama and Merickel are combinable because they are from the same field of endeavor, namely the setting and manipulation of digital image levels to better show the image. At the time of the invention, it would have been obvious to a person of ordinary skill in the art to perform a K-means clustering operation, as taught by Merickel, on the N level digital image taught by Murayama. The motivation for doing so would have been that applying a K-means clustering algorithm would optimize the cluster assignments for the pixels since, upon completion of the iterations, less than one percent of the pixels change cluster assignments (column 11, lines 50-55 of Merickel). Therefore, it would have been obvious to combine Merickel with Murayama.

Murayama in view of Merickel does not disclose expressly that the N level digital image has multiple channels and K-means

clustering and multi-level error diffusion are performed on each of the multiple channels independently.

Eschbach discloses an N level digital image (column 4, lines 18-20 of Eschbach) which has multiple channels (column 4, lines 21-24 of Eschbach), wherein said multiple channels are processed independently (column 4, lines 23-25 of Eschbach).

Murayama in view of Merickel is combinable with Eschbach because they are from the same field of endeavor, namely digital image data halftoning. At the time of the invention, it would have been obvious to a person of ordinary skill in the art to use multiple channel image data, as taught by Eschbach, upon which to perform K-means clustering taught by Merickel and the multi-level error diffusion taught by Murayama, with each channel being processed independently, as taught by Eschbach. The motivation for doing so would have been that independent (column 1, lines 32-35 of Eschbach), separated primary color channels are necessary for the production of digital color images (column 1, lines 24-31 of Eschbach). Therefore, it would have been obvious to combine Eschbach with Murayama in view of Merickel to obtain the invention as specified in claim 7.

10. Claims 8 and 10-11 are rejected under 35 U.S.C. 103(a) as being unpatentable over Murayama (US Patent 5,936,684) in view of Merickel (US Patent 4,945,478), Eschbach (US Patent 5,565,994), and Klassen (US Patent 5,621,546).

Regarding claim 8: Murayama does not disclose expressly that the N level digital image has multiple channels and K-means clustering and multi-level error diffusion are performed in multi-channel vector space.

Merickel discloses performing K-means clustering on a N level digital image (column 11, lines 26-31 and column 15, lines 9-16 of Merickel).

Murayama and Merickel are combinable because they are from the same field of endeavor, namely the setting and manipulation of digital image levels to better show the image. At the time of the invention, it would have been obvious to a person of ordinary skill in the art to perform a K-means clustering operation, as taught by Merickel, on the N level digital image taught by Murayama. The motivation for doing so would have been that applying a K-means clustering algorithm would optimize the cluster assignments for the pixels since, upon completion of the iterations, less than one percent of the pixels change cluster assignments (column 11, lines 50-55 of Merickel). Therefore, it would have been obvious to combine Merickel with Murayama.

Murayama in view of Merickel does not disclose expressly that the N level digital image has multiple channels and K-means clustering and multi-level error diffusion are performed in multi-channel vector space.

Eschbach discloses an N-level digital image (column 4, lines 18-20 of Eschbach) which has multiple channels (column 4, lines 21-24 of Eschbach).

Murayama in view of Merickel is combinable with Eschbach because they are from the same field of endeavor, namely digital image data halftoning. At the time of the invention, it would have been obvious to a person of ordinary skill in the art to use multiple channel image data space, as taught by Eschbach, upon which to perform the K-means clustering taught by Merickel and the multi-level error diffusion taught by Murayama, with each channel being processed independently, as taught by Esch-

bach. The motivation for doing so would have been that independent (column 1, lines 32-35 of Eschbach), separated primary color channels are necessary for the production of digital color images (column 1, lines 24-31 of Eschbach). Therefore, it would have been obvious to combine Eschbach with Murayama in view of Merickel.

Murayama in view of Merickel and Eschbach does not disclose expressly that said multi-level error diffusion is specifically multi-level vector error diffusion.

Klassen discloses performing multi-level vector error diffusion (column 4, line 66 to column 5, line 3 of Klassen).

Murayama in view of Merickel and Eschbach is combinable with Klassen because they are from the same field of endeavor, namely digital image data halftoning. At the time of the invention, it would have been obvious to a person of ordinary skill in the art to specifically perform multi-level vector error diffusion, as taught by Klassen, as said multi-level error diffusion process. The motivation for doing so would have been to consider the effects of the interactions between dot patterns of different color components (column 3, lines 21-27 of Klassen). Therefore, it would have been obvious to combine Klassen with Murayama in view of Merickel and Eschbach to obtain the invention as specified in claim 8.

Regarding claims 10 and 11: Murayama in view of Merickel and Eschbach does not disclose expressly that said multi-level error diffusion is vector error diffusion.

Klassen discloses performing vector error diffusion (column 4, line 66 to column 5, line 3 of Klassen).

Murayama in view of Merickel and Eschbach is combinable with Klassen because they are from the same field of endeavor,

namely digital image data halftoning. At the time of the invention, it would have been obvious to a person of ordinary skill in the art to specifically perform vector error diffusion, as taught by Klassen, as said multi-level error diffusion process. The motivation for doing so would have been to consider the effects of the interactions between dot patterns of different color components (column 3, lines 21-27 of Klassen). Therefore, it would have been obvious to combine Klassen with Murayama in view of Merickel and Eschbach to obtain the invention as specified in claims 10 and 11.

11. Claim 9 is rejected under 35 U.S.C. 103(a) as being unpatentable over Murayama (US Patent 5,936,684) in view of Klassen (US Patent 5,621,546).

Regarding claim 9: Murayama does not disclose expressly that said multi-level error diffusion is vector error diffusion.

Klassen discloses performing vector error diffusion (column 4, line 66 to column 5, line 3 of Klassen).

Murayama and Klassen are combinable because they are from the same field of endeavor, namely digital image data halftoning. At the time of the invention, it would have been obvious to a person of ordinary skill in the art to specifically perform vector error diffusion, as taught by Klassen, as said multi-level error diffusion process. The motivation for doing so would have been to consider the effects of the interactions between dot patterns of different color components (column 3, lines 21-27 of Klassen). Therefore, it would have been obvious to combine Klassen with Murayama to obtain the invention as specified in claim 9.

Claim Rejections - 35 USC § 103

12. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

13. Claims 1, 12, 16 and 21-23 are rejected under 35 U.S.C. 103(a) as being unpatentable over Murayama (US Patent 5,936,684) in view of Revankar (US Patent 5,649,025).

Regarding claims 1 and 12: Murayama discloses a method for multitone processing an N level digital image to produce an M level digital image (figure 4 and column 9, lines 34-39 of Murayama) wherein M and N have unchanging values and M<N (e.g., M=4, N=256), comprising the steps of:

- determining M reconstruction levels (M<N) based on the gray level distribution of the N level image (figure 4 and column 9, lines 34-39 of Murayama); and
- applying multilevel error diffusion (column 14, lines 56-62 of Murayama) to the N level digital image using the M reconstruction levels to produce the M level digital image (figures 8-9 and column 12, lines 58-62 of Murayama),
- wherein said determining further comprises:
    - o assigning all of the pixels of said N level image into M groups corresponding to said M reconstruction levels (figure 4 and column 9, lines 7-18 of Murayama), and
    - o calculating each of said M reconstruction levels using the pixels of the respective said group (figure 4 and

column 9, lines 34-39 of Murayama). Since the calculating of each of said M reconstruction levels requires the use of the pixels of the respective said groups, then it is inherent that said calculating follows said assigning.

However, even if *arguendo*, it is not inherent that said calculating follows said assigning, Revankar discloses initially assigning pixels into M reconstruction levels (column 5, lines 6-9 of Revankar) before calculating each of said M reconstruction levels using the pixels of the respective said group (column 6, line 64 to column 7, line 5 of Revankar).

Murayama and Revankar are combinable because they are from the same field of endeavor, namely digital image data threshold determination. At the time of the invention, it would have been obvious to a person of ordinary skill in the art to iteratively perform the threshold determination, as taught by Revankar, thus initially assigning the value of the M cluster centers before the step of calculating. The motivation for doing so would have been that different portions, or segments, of an image can be better halftoned if multiple thresholds are applied to each region, rather than a single global thresholding (column 2, lines 25-31 of Revankar). Therefore, it would have been obvious to combine Revankar with Murayama to obtain the invention as specified in claims 1 and 12.

Further regarding claim 12: Murayama discloses that the multitone processing method is performed using a computer program (column 14, lines 63-67 of Murayama).

Regarding claim 16: Murayama discloses a method (figure 10 of Murayama) for multitone processing an N level digital image to produce an M level digital image (figure 4 and column 9,

lines 34-39 of Murayama) wherein M and N have unchanging values and M<N (e.g., M=4, N=256), comprising the steps of:

- clustering all of the pixel values (figure 1(S1-S4) of Murayama) of the N level image into M (M<N) reconstruction levels (column 8, lines 23-32 of Murayama) based on the gray level distribution of the N level image (figures 2a-2b; figure 4; and column 9, lines 34-45 of Murayama).
- minimizing error between the N level digital image and the M level digital image during said clustering (figure 2b; column 8, lines 44-49; and column 10, lines 22-24 and equation 5 of Murayama). Said error is minimized as a part of the process of clustering. The even distribution of the threshold values based on the cumulative histogram (figure 2b and column 8, lines 44-49 of Murayama) and the maximization of the interclass variance (column 10, lines 22-24 and equation 5 of Murayama), which also distributes the threshold values as evenly as possible, minimizes the error between the N level digital image and the M level digital image during said clustering.
- applying multilevel error diffusion (figure 1(S5) of Murayama) to the N level digital image using said M reconstruction levels to produce the M level digital image (column 14, lines 56-62 of Murayama). A part of the n value conversion (figure 1(S5) of Murayama) is the application of multilevel error diffusion (column 14, lines 56-62 of Murayama).

Murayama does not disclose expressly repeatedly revising said clustering of said pixel values into said reconstruction levels until error between the N level digital image and the M level digital image is minimized.

Revankar discloses repeatedly revising the clustering of pixel values into reconstruction levels (figure 6(304,306) and column 6, lines 56-65 of Revankar) until a predetermined stopping condition is reached (column 6, line 64 to column 7, line 5 of Revankar).

Murayama and Revankar are combinable because they are from the same field of endeavor, namely digital image data threshold determination. At the time of the invention, it would have been obvious to a person of ordinary skill in the art to iteratively perform the threshold determination, as taught by Revankar, and thus the clustering taught by Murayama until a predetermined stopping condition is reached, as taught by Revankar, which would be the minimum error taught by Murayama. The error minimization taught by Murayama minimizes said error in terms of only one iteration of said clustering. With repeated iterations of said clustering, which would inherently occur after the first said clustering, said error would be minimized using the stopping condition criteria, as taught by Revankar. The motivation for doing so would have been that different portions, or segments, of an image can be better halftoned if multiple thresholds are applied to each region, rather than a single global thresholding (column 2, lines 25-31 of Revankar), and it would have been clear to one of ordinary skill in the art at the time of the invention that minimizing error in image document reproduction is desirable. Therefore, it would have been obvious to combine Revankar with Murayama to obtain the invention as specified in claim 16.

Regarding claim 21: Murayama discloses a method for multitone processing an N level digital image to produce an M level digital image (figure 4 and column 9, lines 34-39 of Murayama)

wherein M and N have unchanging values and M<N (e.g., M=4, N=256), comprising the steps of:

- assigning pixels of the N level digital image to the M cluster centers to provide assigned pixels (column 8, lines 44-49 of Murayama);
- calculating values of said cluster centers based upon respective said assigned pixel (figure 4 and column 9, lines 34-45 of Murayama);
- selecting final values of said cluster centers as reconstruction levels (figure 4 and column 9, lines 34-39 of Murayama);
- applying multilevel error diffusion (column 14, lines 56-62 of Murayama) to the N level digital image using said reconstruction levels to produce the M level digital image (figures 8-9 and column 12, lines 58-62 of Murayama).

Murayama does not disclose expressly setting initial values of M cluster centers; and repeating said assigning and said calculating until a predetermined stopping condition is reached and, thereby, final values of said cluster centers are defined.

<u>Revankar discloses:</u>

- setting initial values of M cluster centers (column 5, lines 6-9 of Revankar);
- repeating the overall threshold operations (figure 6(304, 306) and column 6, lines 56-65 of Revankar) until a predetermined stopping condition is reached (column 7, lines 1-5 of Revankar) and, thereby, final values of said cluster centers are defined (column 7, lines 1-5 of Revankar).

Murayama and Revankar are combinable because they are from the same field of endeavor, namely digital image data threshold

determination. At the time of the invention, it would have been obvious to a person of ordinary skill in the art to iteratively perform the threshold determination, as taught by Revankar, thus initially setting the value of the M cluster centers and repeating said assigning and calculating steps taught by Murayama until a predetermined stopping condition is reached, as taught by Revankar. The motivation for doing so would have been that different portions, or segments, of an image can be better halftoned if multiple thresholds are applied to each region, rather than a single global thresholding (column 2, lines 25-31 of Revankar). Therefore, it would have been obvious to combine Revankar with Murayama to obtain the invention as specified in claim 21.

Regarding claim 22: Murayama discloses that said assigning minimizes respective mean squared error (figure 5(S23) and column 10, lines 22-24 and equation 5 of Murayama). Maximizing the interclass variance (figure 5(S23) and column 10, lines 22-24 and equation 5 of Murayama), distributes the threshold values as evenly as possible. Since the equation for variance is based on the square of the difference between the respective classes (figure 5(23) and column 10, equation 5 of Murayama), the respective mean squared error is minimized.

Regarding claim 23: Murayama discloses that the stopping condition is a predetermined threshold (column 8, lines 23-29 of Murayama). After the [n-1]th threshold has been determined, the threshold determination is stopped (column 8, lines 23-29 of Murayama).

14. Claim 2 is rejected under 35 U.S.C. 103(a) as being unpatentable over Murayama (US Patent 5,936,684) in view of Merickel (US Patent 4,945,478).

Regarding claim 2: Murayama discloses:

- determining M reconstruction levels (M<N) based on the gray level distribution of the N level image (figure 4 and column 9, lines 34-39 of Murayama);
- applying multilevel dithering (column 14, lines 56-62 of Murayama) to the N level digital image using the M reconstruction levels to produce the M level digital image (figures 8-9 and column 12, lines 58-62 of Murayama).

Murayama does not disclose expressly that said determining step comprises performing a K-means clustering operation on the N level digital image, wherein K=M.

Merickel discloses performing a K-means clustering operation on an N level digital image (column 11, lines 26-31 and column 15, lines 9-16 of Merickel).

Murayama and Merickel are combinable because they are from the same field of endeavor, namely the setting and manipulation of digital image levels to better show the image. At the time of the invention, it would have been obvious to a person of ordinary skill in the art to perform a K-means clustering operation, as taught by Merickel, on the N level digital image taught by Murayama. Since the pertinent number of levels in Murayama is the M number of levels for the digital image, K would equal M when the teachings of Merickel are combined with the primary teachings of Murayama. The motivation for doing so would have been that applying a K-means clustering algorithm would optimize the cluster assignments for the pixels since, upon completion of the iterations, less than one percent of the

pixels change cluster assignments (column 11, lines 50-55 of Merickel). Therefore, it would have been obvious to combine Merickel with Murayama to obtain the invention as specified in claim 2.

15. Claims 3 and 13 are rejected under 35 U.S.C. 103(a) as being unpatentable over Murayama (US Patent 5,936,684) in view of Ishiguro (US Patent 6,501,566 B1).

Regarding claim 3: Murayama discloses:

- determining M reconstruction levels (M<N) based on the gray level distribution of the N level image (figure 4 and column 9, lines 34-39 of Murayama);
- applying multilevel error diffusion (column 14, lines 56-62 of Murayama) to the N level digital image (figures 8-9 and column 12, lines 58-62 of Murayama);
- forming a histogram of the N level digital image (figure 2a and column 7, lines 26-31 of Murayama).

Murayama does not disclose expressly locating said M reconstruction levels corresponding to the M most prominent peaks in the histogram.

Ishiguro discloses locating M reconstruction levels (denoted by N in Ishiguro) (column 3, lines 24-25 of Ishiguro) corresponding to the M most prominent peaks in the histogram (figure 7 and column 7, lines 23-26 and lines 59-65 of Ishiguro). A histogram is created (figure 7 and column 7, lines 23-26 of Ishiguro) which set the pixel reference levels based on the number of pixels with densities within a set range (figure 7 and column 7, lines 59-65 of Ishiguro). As can clearly be seen from figure 7 of Ishiguro, this results in the four density levels (S0 to S3) corresponding to the four most prominent peaks

in the histogram. This is further evidenced by the language of claim 14 of Ishiguro (column 10, lines 57-60 of Ishiguro).

Murayama and Ishiguro are combinable because they are from the same field of endeavor, namely digital image binarization. At the time of the invention, it would have been obvious to a person of ordinary skill in the art to set the M levels (M<N), taught by both Murayama and Ishiguro, based on the M most prominent peaks of said histogram, as taught by Ishiguro. The motivation for doing so would have been to prevent degradation of the image quality when error diffusion is performed, which is a common result for predetermined threshold values (column 2, lines 57-65 of Ishiguro). Therefore, it would have been obvious to combine Ishiguro with Murayama to obtain the invention as specified in claim 3.

Regarding claim 13: Murayama does not disclose expressly that the first and last levels of the M levels are predetermined, wherein the first level is zero and the last level is the maximum possible level.

Ishiguro discloses that the first and last levels of the M levels are predetermined, wherein the first level (S0) is zero and the last level (S3) is the maximum possible level (figure 7; column 7, lines 24-26 and column 8, lines 31-34 of Ishiguro).

Murayama and Ishiguro are combinable because they are from the same field of endeavor, namely digital image binarization. At the time of the invention, it would have been obvious to a person of ordinary skill in the art to preset the first level to zero and the last level to the maximum possible level, as taught by Ishiguro. The suggestion for doing so would have been that halftone text data, which has lot of dark pixel surrounded by light pixels, is a common feature in images (column 2, lines 61-

63 of Ishiguro). This produces the peaks at the low density end and high density end of the histogram, such as shown in figure 7 of Ishiguro. Thus, the first and last levels should be set to zero and the maximum possible level, respectively. Therefore, it would have been obvious to combine Ishiguro with Murayama to obtain the invention as specified in claim 13.

16. Claims 4-6, 18 and 24 are rejected under 35 U.S.C. 103(a) as being unpatentable over Murayama (US Patent 5,936,684) in view of Revankar (US Patent 5,649,025) and Ishiguro (US Patent 6,501,566 B1).

Regarding claims 4-6 and 18: Murayama in view of Revankar does not disclose expressly that the first and last levels of the M levels are predetermined, wherein the first level is zero and the last level is the maximum possible level.

Ishiguro discloses that the first and last levels of the M levels are predetermined, wherein the first level (S0) is zero and the last level (S3) is the maximum possible level (figure 7; column 7, lines 24-26 and column 8, lines 31-34 of Ishiguro).

Murayama in view of Revankar is combinable with Ishiguro because they are from the same field of endeavor, namely digital image binarization. At the time of the invention, it would have been obvious to a person of ordinary skill in the art to preset the first level to zero and the last level to the maximum possible level, as taught by Ishiguro. The suggestion for doing so would have been that halftone text data, which has lot of dark pixel surrounded by light pixels, is a typical feature in images (column 2, lines 61-63 of Ishiguro). This produces the peaks at the low density end and high density end of the histogram, such as shown in figure 7 of Ishiguro. Thus, the

first and last levels should be set to zero and the maximum possible level, respectively. Therefore, it would have been obvious to combine Ishiguro with Murayama in view of Revankar to obtain the invention as specified in claims 4-6.

Regarding claim 24: Murayama in view of Revankar does not disclose expressly that the first and last levels of the M levels are predetermined.

Ishiguro discloses that the first and last levels of the M levels are predetermined (figure 7; column 7, lines 24-26 and column 8, lines 31-34 of Ishiguro).

Murayama in view of Revankar is combinable with Ishiguro because they are from the same field of endeavor, namely digital image binarization. At the time of the invention, it would have been obvious to a person of ordinary skill in the art to preset the first level to zero and the last level to the maximum possible level, as taught by Ishiguro. The suggestion for doing so would have been that halftone text data, which has lot of dark pixel surrounded by light pixels, is a common feature in images (column 2, lines 61-63 of Ishiguro). This produces the peaks at the low density end and high density end of the histogram, such as shown in figure 7 of Ishiguro. Thus, the first and last levels should be set to zero and the maximum possible level, respectively. Therefore, it would have been obvious to combine Ishiguro with Murayama in view of Revankar to obtain the invention as specified in claim 24.

17. Claims 7 and 19 are rejected under 35 U.S.C. 103(a) as being unpatentable over Murayama (US Patent 5,936,684) in view of Revankar (US Patent 5,649,025), Merickel (US Patent 4,945,478), and Eschbach (US Patent 5,565,994).

Regarding claims 7 and 19: Murayama in view of Revankar does not disclose expressly that the N level digital image has multiple channels and K-means clustering and multi-level error diffusion are performed on each of the multiple channels independently.

Merickel discloses performing K-means clustering on a N level digital image (column 11, lines 26-31 and column 15, lines 9-16 of Merickel).

Murayama in view of Revankar is combinable with Merickel because they are from the same field of endeavor, namely the setting and manipulation of digital image levels to better show the image. At the time of the invention, it would have been obvious to a person of ordinary skill in the art to perform a K-means clustering operation, as taught by Merickel, on the N level digital image taught by Murayama. The motivation for doing so would have been that applying a K-means clustering algorithm would optimize the cluster assignments for the pixels since, upon completion of the iterations, less than one percent of the pixels change cluster assignments (column 11, lines 50-55 of Merickel). Therefore, it would have been obvious to combine Merickel with Murayama in view of Revankar.

Murayama in view of Revankar and Merickel does not disclose expressly that the N level digital image has multiple channels and K-means clustering and multi-level error diffusion are performed on each of the multiple channels independently.

Eschbach discloses an N level digital image (column 4, lines 18-20 of Eschbach) which has multiple channels (column 4, lines 21-24 of Eschbach), wherein said multiple channels are processed independently (column 4, lines 23-25 of Eschbach).

Murayama in view of Revankar and Merickel is combinable with Eschbach because they are from the same field of endeavor, namely digital image data halftoning. At the time of the invention, it would have been obvious to a person of ordinary skill in the art to use multiple channel image data, as taught by Eschbach, upon which to perform K-means clustering taught by Merickel and the multi-level error diffusion taught by Murayama, with each channel being processed independently, as taught by Eschbach. The motivation for doing so would have been that independent (column 1, lines 32-35 of Eschbach), separated primary color channels are necessary for the production of digital color images (column 1, lines 24-31 of Eschbach). Therefore, it would have been obvious to combine Eschbach with Murayama in view of Revankar and Merickel to obtain the invention as specified in claims 7 and 19.

18. Claims 8, 10-11 and 20 rejected under 35 U.S.C. 103(a) as being unpatentable over Murayama (US Patent 5,936,684) in view of Revankar (US Patent 5,649,025), Merickel (US Patent 4,945,478), Eschbach (US Patent 5,565,994), and Klassen (US Patent 5,621,546).

Regarding claims 8 and 20: Murayama in view of Revankar does not disclose expressly that the N level digital image has multiple channels and K-means clustering and multi-level error diffusion are performed in multi-channel vector space.

Merickel discloses performing K-means clustering on a N level digital image (column 11, lines 26-31 and column 15, lines 9-16 of Merickel).

Murayama in view of Revankar is combinable with Merickel because they are from the same field of endeavor, namely the setting and manipulation of digital image levels to better show the image. At the time of the invention, it would have been obvious to a person of ordinary skill in the art to perform a K-means clustering operation, as taught by Merickel, on the N level digital image taught by Murayama. The motivation for doing so would have been that applying a K-means clustering algorithm would optimize the cluster assignments for the pixels since, upon completion of the iterations, less than one percent of the pixels change cluster assignments (column 11, lines 50-55 of Merickel). Therefore, it would have been obvious to combine Merickel with Murayama in view of Revankar.

Murayama in view of Revankar and Merickel does not disclose expressly that the N level digital image has multiple channels and K-means clustering and multi-level error diffusion are performed in multi-channel vector space.

Eschbach discloses an N-level digital image (column 4, lines 18-20 of Eschbach) which has multiple channels (column 4, lines 21-24 of Eschbach).

Murayama in view of Revankar and Merickel is combinable with Eschbach because they are from the same field of endeavor, namely digital image data halftoning. At the time of the invention, it would have been obvious to a person of ordinary skill in the art to use multiple channel image data space, as taught by Eschbach, upon which to perform the K-means clustering taught by Merickel and the multi-level error diffusion taught by

Murayama, with each channel being processed independently, as taught by Eschbach. The motivation for doing so would have been that independent (column 1, lines 32-35 of Eschbach), separated primary color channels are necessary for the production of digital color images (column 1, lines 24-31 of Eschbach). Therefore, it would have been obvious to combine Eschbach with Murayama in view of Revankar and Merickel.

Murayama in view of Revankar, Merickel and Eschbach does not disclose expressly that said multi-level error diffusion is specifically multi-level vector error diffusion.

Klassen discloses performing multi-level vector error diffusion (column 4, line 66 to column 5, line 3 of Klassen).

Murayama in view of Revankar, Merickel and Eschbach is combinable with Klassen because they are from the same field of endeavor, namely digital image data halftoning. At the time of the invention, it would have been obvious to a person of ordinary skill in the art to specifically perform multi-level vector error diffusion, as taught by Klassen, as said multi-level error diffusion process. The motivation for doing so would have been to consider the effects of the interactions between dot patterns of different color components (column 3, lines 21-27 of Klassen). Therefore, it would have been obvious to combine Klassen with Murayama in view of Revankar, Merickel and Eschbach to obtain the invention as specified in claims 8 and 20.

Regarding claims 10 and 11: Murayama in view of Revankar, Merickel and Eschbach does not disclose expressly that said multi-level error diffusion is vector error diffusion.

Klassen discloses performing vector error diffusion (column 4, line 66 to column 5, line 3 of Klassen).

Murayama in view of Revankar, Merickel and Eschbach is combinable with Klassen because they are from the same field of endeavor, namely digital image data halftoning. At the time of the invention, it would have been obvious to a person of ordinary skill in the art to specifically perform vector error diffusion, as taught by Klassen, as said multi-level error diffusion process. The motivation for doing so would have been to consider the effects of the interactions between dot patterns of different color components (column 3, lines 21-27 of Klassen). Therefore, it would have been obvious to combine Klassen with Murayama in view of Revankar, Merickel and Eschbach to obtain the invention as specified in claims 10 and 11.

19. Claim 9 is rejected under 35 U.S.C. 103(a) as being unpatentable over Murayama (US Patent 5,936,684) in view of Revankar (US Patent 5,649,025) and Klassen (US Patent 5,621,546).

Regarding claim 9: Murayama in view of Revankar does not disclose expressly that said multi-level error diffusion is vector error diffusion.

Klassen discloses performing vector error diffusion (column 4, line 66 to column 5, line 3 of Klassen).

Murayama in view of Revankar is combinable with Klassen because they are from the same field of endeavor, namely digital image data halftoning. At the time of the invention, it would have been obvious to a person of ordinary skill in the art to specifically perform vector error diffusion, as taught by Klassen, as said multi-level error diffusion process. The motivation for doing so would have been to consider the effects of the interactions between dot patterns of different color

components (column 3, lines 21-27 of Klassen). Therefore, it would have been obvious to combine Klassen with Murayama in view of Revankar to obtain the invention as specified in claim 9.

20. Claim 14 is rejected under 35 U.S.C. 103(a) as being unpatentable over Murayama (US Patent 5,936,684) in view of Ishiguro (US Patent 6,501,566 B1) and Eschbach (US Patent 5,565,994).

Regarding claim 14: Murayama in view of Ishiguro does not disclose expressly that the N level digital image has multiple channels and said determining and applying steps are applied to each of said multiple channels independently.

Eschbach discloses an N level digital image (column 4, lines 18-20 of Eschbach) which has multiple channels (column 4, lines 21-24 of Eschbach), wherein said multiple channels are processed independently (column 4, lines 23-25 of Eschbach).

Murayama in view of Ishiguro is combinable with Eschbach because they are from the same field of endeavor, namely digital image data halftoning. At the time of the invention, it would have been obvious to a person of ordinary skill in the art to use multiple channel image data, as taught by Eschbach, upon which to perform said determining and applying steps, as taught by Murayama in view of Ishiguro, with each channel being processed independently, as taught by Eschbach. The motivation for doing so would have been that independent (column 1, lines 32-35 of Eschbach), separated primary color channels are necessary for the production of digital color images (column 1, lines 24-31 of Eschbach). Therefore, it would have been obvious to combine Eschbach with Murayama in view of Ishiguro to obtain the invention as specified in claim 14.

21. Claim 15 is rejected under 35 U.S.C. 103(a) as being unpatentable over Murayama (US Patent 5,936,684) in view of Ishiguro (US Patent 6,501,566 B1), Eschbach (US Patent 5,565,994), and Klassen (US Patent 5,621,546).

Regarding claim 15: Murayama in view of Ishiguro does not disclose expressly that the N level digital image has multiple channels and said determining and applying steps are performed in multi-channel vector space.

Eschbach discloses an N-level digital image (column 4, lines 18-20 of Eschbach) which has multiple channels (column 4, lines 21-24 of Eschbach).

Murayama in view of Ishiguro is combinable with Eschbach because they are from the same field of endeavor, namely digital image data halftoning. At the time of the invention, it would have been obvious to a person of ordinary skill in the art to use multiple channel image data space, as taught by Eschbach, upon which to perform said determining and applying steps, as taught by Murayama in view of Ishiguro, with each channel being processed independently, as taught by Eschbach. The motivation for doing so would have been that independent (column 1, lines 32-35 of Eschbach), separated primary color channels are necessary for the production of digital color images (column 1, lines 24-31 of Eschbach). Therefore, it would have been obvious to combine Eschbach with Murayama in view of Ishiguro.

Murayama in view of Ishiguro and Eschbach does not disclose expressly that said multi-channel image space is specifically multi-channel vector space.

Klassen discloses performing multi-level vector error diffusion (column 4, line 66 to column 5, line 3 of Klassen).

Murayama in view of Ishiguro and Eschbach is combinable with Klassen because they are from the same field of endeavor, namely digital image data halftoning. At the time of the invention, it would have been obvious to a person of ordinary skill in the art to specifically perform multi-level vector error diffusion, as taught by Klassen, as said multi-level error diffusion process, thus making said multi-channel image space specifically a multi-channel vector space. The motivation for doing so would have been to consider the effects of the interactions between dot patterns of different color components (column 3, lines 21-27 of Klassen). Therefore, it would have been obvious to combine Klassen with Murayama in view of Ishiguro and Eschbach to obtain the invention as specified in claim 15.

22. Claim 17 is rejected under 35 U.S.C. 103(a) as being unpatentable over Murayama (US Patent 5,936,684) in view of Revankar (US Patent 5,649,025) and Merickel (US Patent 4,945,478).

Regarding claim 17: Murayama in view of Revankar does not disclose expressly that said clustering and minimizing steps further comprise performing a K-means clustering operation on the N level digital image, wherein K=M.

Merickel discloses performing a K-means clustering operation on an N level digital image (column 11, lines 26-31 and column 15, lines 9-16 of Merickel).

Murayama in view of Revankar is combinable with Merickel because they are from the same field of endeavor, namely the setting and manipulation of digital image levels to better show the image. At the time of the invention, it would have been obvious to a person of ordinary skill in the art to perform a K-

means clustering operation, as taught by Merickel, on the N level digital image taught by Murayama. Since the pertinent number of levels in Murayama is the M number of levels for the digital image, K would equal M when the teachings of Merickel are combined with the primary teachings of Murayama. The motivation for doing so would have been that applying a K-means clustering algorithm would optimize the cluster assignments for the pixels since, upon completion of the iterations, less than one percent of the pixels change cluster assignments (column 11, lines 50-55 of Merickel). Therefore, it would have been obvious to combine Merickel with Murayama in view of Revankar to obtain the invention as specified in claim 17.

23. Claim 25 is rejected under 35 U.S.C. 103(a) as being unpatentable over Murayama (US Patent 5,936,684) in view of Revankar (US Patent 5,649,025) and Eschbach (US Patent 5,565,994).

Regarding claim 25: Murayama in view of Revankar does not disclose expressly that the N level digital image has multiple channels and said setting, assigning, calculating, repeating, selecting and applying steps are performed independently on each of said multiple channels.

Eschbach discloses an N level digital image (column 4, lines 18-20 of Eschbach) which has multiple channels (column 4, lines 21-24 of Eschbach), wherein said multiple channels are processed independently (column 4, lines 23-25 of Eschbach).

Murayama in view of Revankar is combinable with Eschbach because they are from the same field of endeavor, namely digital image data halftoning. At the time of the invention, it would have been obvious to a person of ordinary skill in the art to

use multiple channel image data, as taught by Eschbach, upon which to perform said setting, assigning, calculating, repeating, selecting and applying steps, as taught by Murayama, with each channel being processed independently, as taught by Eschbach. The motivation for doing so would have been that independent (column 1, lines 32-35 of Eschbach), separated primary color channels are necessary for the production of digital color images (column 1, lines 24-31 of Eschbach). Therefore, it would have been obvious to combine Eschbach with Murayama in view of Revankar to obtain the invention as specified in claim 25.

24. Claim 26 is rejected under 35 U.S.C. 103(a) as being unpatentable over Murayama (US Patent 5,936,684) in view of Revankar (US Patent 5,649,025), Eschbach (US Patent 5,565,994), and Klassen (US Patent 5,621,546).

Regarding claim 26: Murayama in view of Revankar does not disclose expressly that the N level digital image has multiple channels and said setting, assigning, calculating, repeating, selecting and applying steps are performed in multi-channel vector space.

Eschbach discloses an N-level digital image (column 4, lines 18-20 of Eschbach) which has multiple channels (column 4, lines 21-24 of Eschbach).

Murayama in view of Revankar is combinable with Eschbach because they are from the same field of endeavor, namely digital image data halftoning. At the time of the invention, it would have been obvious to a person of ordinary skill in the art to use multiple channel image data space, as taught by Eschbach, upon which to perform said setting, assigning, calculating,

repeating, selecting and applying steps, as taught by Murayama, with each channel being processed independently, as taught by Eschbach. The motivation for doing so would have been that independent (column 1, lines 32-35 of Eschbach), separated primary color channels are necessary for the production of digital color images (column 1, lines 24-31 of Eschbach). Therefore, it would have been obvious to combine Eschbach with Murayama in view of Revankar.

Murayama in view of Revankar and Eschbach does not disclose expressly that said multi-channel image space is specifically multi-channel vector space.

Klassen discloses performing multi-level vector error diffusion (column 4, line 66 to column 5, line 3 of Klassen).

Murayama in view of Revankar and Eschbach is combinable with Klassen because they are from the same field of endeavor, namely digital image data halftoning. At the time of the invention, it would have been obvious to a person of ordinary skill in the art to specifically perform multi-level vector error diffusion, as taught by Klassen, as said multi-level error diffusion process, thus making said multi-channel image space specifically a multi-channel vector space. The motivation for doing so would have been to consider the effects of the interactions between dot patterns of different color components (column 3, lines 21-27 of Klassen). Therefore, it would have been obvious to combine Klassen with Murayama in view of Revankar and Eschbach to obtain the invention as specified in claim 26.

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to James A. Thompson whose telephone number is 571-272-7441. The examiner can normally be reached on 8:30AM-5:00PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, David K. Moore can be reached on 571-272-7437. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

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